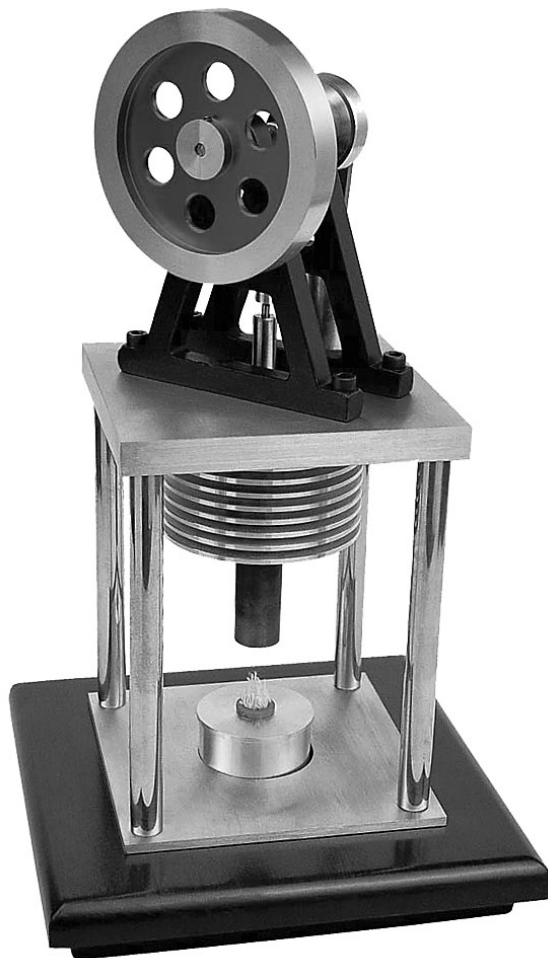


# *Grizzly* *Industrial, Inc.*®

## **MODEL H8103 STIRLING ENGINE KIT 3 OWNER'S MANUAL**



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**WARNING: NO PORTION OF THIS MANUAL MAY BE REPRODUCED IN ANY SHAPE  
OR FORM WITHOUT THE WRITTEN APPROVAL OF GRIZZLY INDUSTRIAL, INC.**  
#TS9304 PRINTED IN CHINA

 **WARNING!**

**This manual provides critical safety instructions on the proper setup, operation, maintenance and service of this machine/equipment.**

**Failure to read, understand and follow the instructions given in this manual may result in serious personal injury, including amputation, electrocution or death.**

**The owner of this machine/equipment is solely responsible for its safe use. This responsibility includes but is not limited to proper installation in a safe environment, personnel training and usage authorization, proper inspection and maintenance, manual availability and comprehension, application of safety devices, blade/cutter integrity, and the usage of personal protective equipment.**

**The manufacturer will not be held liable for injury or property damage from negligence, improper training, machine modifications or misuse.**

 **WARNING!**

**Some dust created by power sanding, sawing, grinding, drilling, and other construction activities contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:**

- **Lead from lead-based paints.**
- **Crystalline silica from bricks, cement and other masonry products.**
- **Arsenic and chromium from chemically-treated lumber.**

**Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: Work in a well ventilated area, and work with approved safety equipment, such as those dust masks that are specially designed to filter out microscopic particles.**

# Introduction

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## Foreword

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We are proud to offer the Model H8103 Stirling Engine Kit 3. When used according to the guidelines set forth in this manual, you can expect years of trouble-free, enjoyable operation and proof of Grizzly's commitment to customer satisfaction.

The specifications, drawings, and photographs illustrated in this manual represent the Model H8103 when the manual was prepared. However, owing to Grizzly's policy of continuous improvement, changes may be made at any time with no obligation on the part of Grizzly.

For your convenience, we always keep current Grizzly manuals available on our website at **www.grizzly.com**. Any updates to your machine will be reflected in these manuals as soon as they are complete. Visit our site often to check for the latest updates to this manual!

## Contact Info

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If you have any comments regarding this manual, please write to us at the address below:

Grizzly Industrial, Inc.  
c/o Technical Documentation Manager  
P.O. Box 2069  
Bellingham, WA 98227-2069  
Email: manuals@grizzly.com

We stand behind our machines. If you have any service questions or parts requests, please call or write us at the location listed below.

Grizzly Industrial, Inc.  
1203 Lycoming Mall Circle  
Muncy, PA 17756  
Phone: (570) 546-9663  
Fax: (800) 438-5901  
E-Mail: techsupport@grizzly.com  
Web Site: <http://www.grizzly.com>

## The Stirling Engine

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The Stirling Engine was invented and developed by Reverend Dr. Robert Stirling and his brother, James, in the early 1800's.

In the conversion of heat into mechanical work, Stirling engines can achieve the highest efficiency of any real heat engine, limited only by the properties of the working gas, engine materials, and friction. These engines can run on any heat source of sufficient quality, including solar, chemical, and nuclear.

Compared to an internal combustion engine of a given power rating, Stirling engines have a higher initial cost and are usually larger and heavier. However, in recent years, the advantages of Stirling engines have become increasingly significant due to the rising concerns over energy and environmental issues.

The Stirling engine is a closed system and contains a fixed quantity of gas that, in this kit, is air. Unlike other types of piston engines that require outside ventilation, the Stirling engine is sealed, no gas enters or leaves the engine, and no valves are required. The Stirling engine cycles through four main processes—cooling, compression, heating and expansion. This is accomplished by moving the enclosed air back and forth between hot and cold heat exchangers.

The round, horizontal heating exchanger in contact with the alcohol burner warms the working air and the smaller cylinder on top cools it. A change in the enclosed air temperature will cause a corresponding change in gas pressure, while the motion of the piston causes the enclosed air to be alternately expanded and compressed.

In summary, the Stirling engine uses the energy difference between its hot and cold ends to create a cycle of alternately expanding and contracting a fixed amount of enclosed gas, and converting the temperature differences into mechanical power.



# Safety

## WARNING

### For Your Own Safety, Read Instruction Manual Before Operating this Machine

The purpose of safety symbols is to attract your attention to possible hazardous conditions. This manual uses a series of symbols and signal words intended to convey the level of importance of the safety messages. The progression of symbols is described below. Remember that safety messages by themselves do not eliminate danger and are not a substitute for proper accident prevention measures.



Indicates an imminently hazardous situation which, if not avoided, **WILL** result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, **COULD** result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, **MAY** result in minor or moderate injury. It may also be used to alert against unsafe practices.

**NOTICE**

This symbol is used to alert the user to useful information about proper operation of the machine.

## WARNING

### Safety Instructions for Machinery

- 1. READ THE ENTIRE MANUAL BEFORE STARTING MACHINERY.** Machinery presents serious injury hazards to untrained users.
- 2. ALWAYS USE ANSI APPROVED SAFETY GLASSES WHEN OPERATING MACHINERY.** Everyday eyeglasses only have impact resistant lenses—they are NOT safety glasses.
- 3. ALWAYS WEAR A NIOSH APPROVED RESPIRATOR WHEN OPERATING MACHINERY THAT PRODUCES DUST.** Wood dust can cause severe respiratory illnesses.
- 4. ALWAYS USE HEARING PROTECTION WHEN OPERATING MACHINERY.** Machinery noise can cause permanent hearing loss.
- 5. WEAR PROPER APPAREL. DO NOT** wear loose clothing, gloves, neckties, rings, or jewelry that can catch in moving parts. Wear protective hair covering to contain long hair and wear non-slip footwear.
- 6. NEVER OPERATE MACHINERY WHEN TIRED OR UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.** Be mentally alert at all times when running machinery.



# WARNING

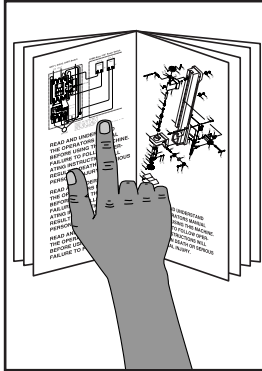
## Safety Instructions for Flammable Liquids

- 1. ADEQUATE VENTILATION.** A build-up of alcohol fumes can present an explosion hazard. Always make sure there is enough ventilation around the Stirling engine when it is in use.
- 2. ISOPROPYL ALCOHOL.** Use only any commercially available isopropyl alcohol that is 99% pure. DO NOT mix this alcohol with other chemicals or substitute any other flammable substance or source to heat the Stirling engine.
- 3. RESPONSIBLE USE.** Using a Stirling engine can present a fire hazard if not properly operated. Make sure that the operator of the engine is capable of handling the alcohol fuel and the hot engine. DO NOT let children operate this Stirling engine.
- 4. KEEP AWAY FROM ELECTRICAL SOURCES.** Any electrical device or source can produce a spark that may ignite the alcohol fuel as it is being handled—such as cell phones, electrical outlets, computers, etc. Make sure the alcohol fuel is stored in proper containers away from electrical sources. Keep the Stirling engine safely away from electrical sources when in operation.
- 5. REMOVE ALCOHOL AFTER USE.** Properly dispose or store any alcohol left in the reservoir of the Stirling engine after use. The flammable liquid in the reservoir can spill during movement and become a fire hazard.
- 6. AVOID HOT ENGINE PARTS.** During the use of the Stirling engine, many parts become hot enough to burn the skin. DO NOT touch these parts until they are completely cooled.
- 7. ALCOHOL DISPOSAL.** Always check your local codes and standards for proper disposal of flammable substances.
- 8. CLEAN UP ANY SPILLS.** Although isopropyl alcohol will evaporate with time, a spill of this flammable liquid can present a fire hazard. If left for a period of time, isopropyl alcohol can damage other materials.
- 9. DO NOT DRINK ALCOHOL FUEL.** Ingesting any type of alcohol fuel can lead to blindness or death. Keep containers of alcohol fuel tightly sealed and away from children.
- 10. AVOID EYE OR SKIN CONTACT WITH ALCOHOL FUEL.** Alcohol fuel can damage eyes. Prolonged exposure of the skin to alcohol fuels can result in skin irritations. Avoid any personal contact with alcohol fuels, including ingestion.
- 11. DO NOT LEAVE UNATTENDED.** Always directly supervise the Stirling engine when the alcohol fuel is lit or the engine parts are hot.
- 12. FIRE SAFETY.** Always keep a fire extinguisher near when operating the Stirling engine or servicing the fuel reservoir. DO NOT have any other open flames or sources of sparks near the alcohol fuel at any time. DO NOT smoke near the alcohol fuel.
- 13. SAFE ATTIRE.** Tie back long hair and loose clothing when operating the Stirling engine or working with the alcohol fuel.
- 14. EXPERIENCING DIFFICULTIES.** If at any time you are experiencing difficulties performing the intended operation, stop using the engine! Contact our Technical Support at (570) 546-9663.



# Setup

## Setup Safety



**! WARNING**  
This machine presents serious injury hazards to untrained users. Read through this entire manual to become familiar with the controls and operations before starting the machine!



**! WARNING**  
Wear safety glasses during the entire setup process!

## Items Needed for Setup

The following items are needed to complete the setup process, but are not included with your Stirling engine:

Description	Qty
• Safety Glasses .....	1
• Hex Wrenches 3,4mm.....	1 Ea
• Small Needle Nose Pliers .....	1
• Standard Screwdriver 3mm.....	1
• Phillips Head Screwdriver #1 .....	1
• Compressed Air (for cleaning) ...	As Needed
• Light Machine Oil .....	As Needed

## Unpacking

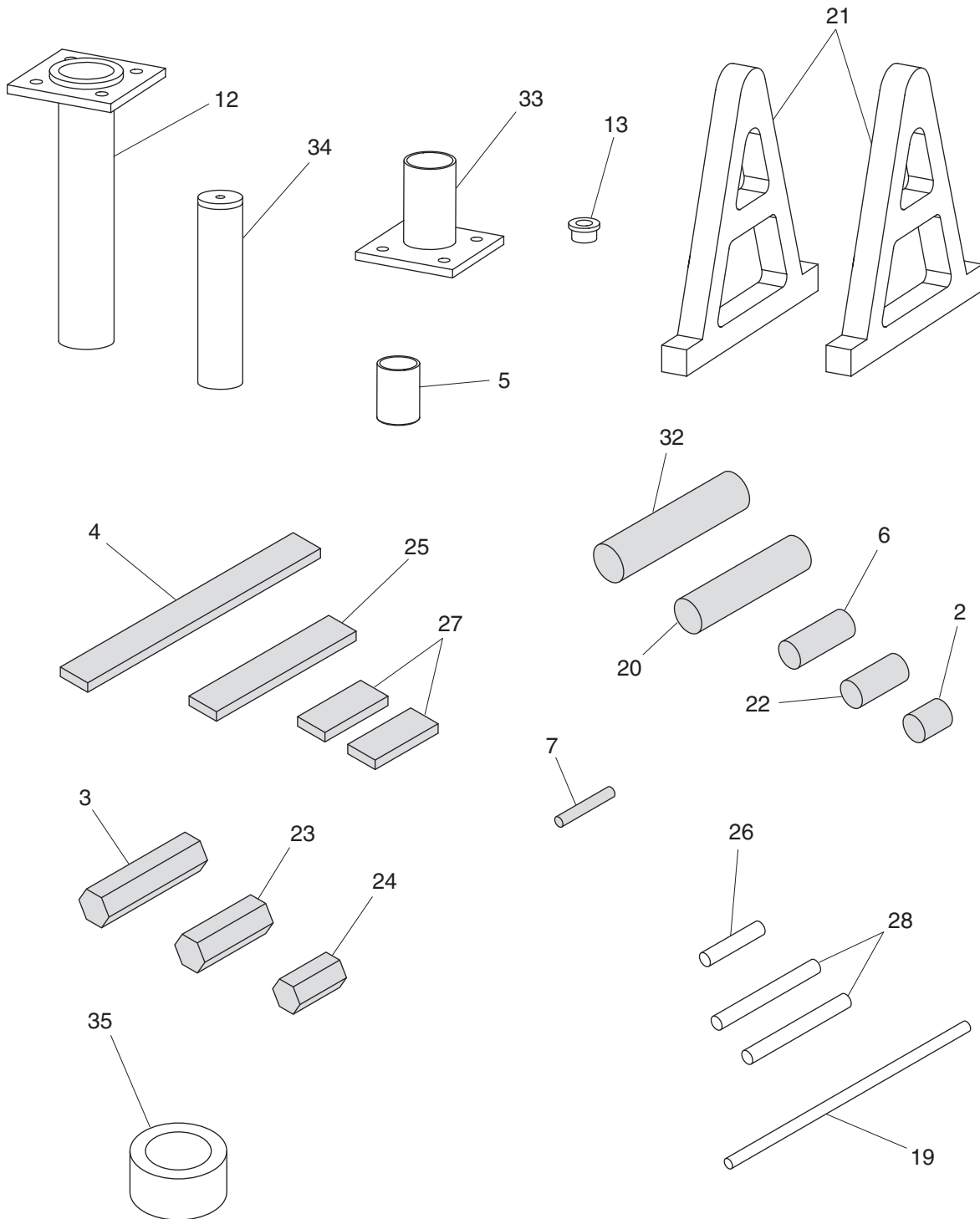
The Model H8103 was carefully packed when it left our warehouse. If you discover the contents are damaged after you have signed for delivery, *please immediately call Customer Service at (570) 546-9663 for advice.*

Save the containers and all packing materials for possible inspection by the carrier or its agent. *Otherwise, filing a freight claim can be difficult.*

When you are completely satisfied with the condition of your shipment, use the next 2 pages to inventory the contents.

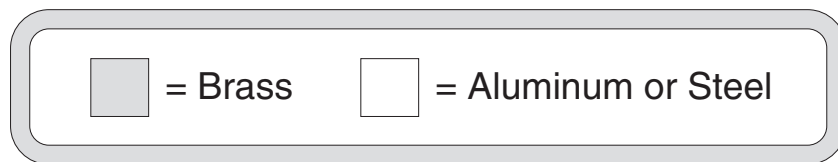
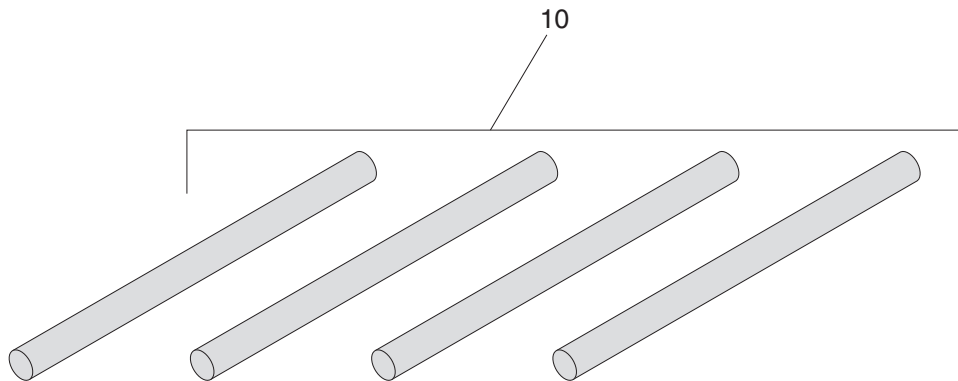
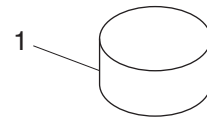
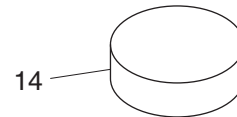
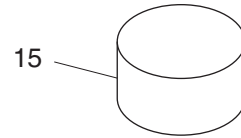
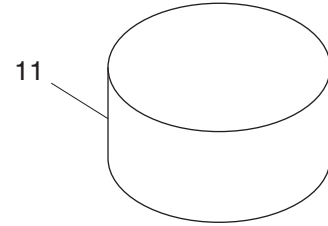
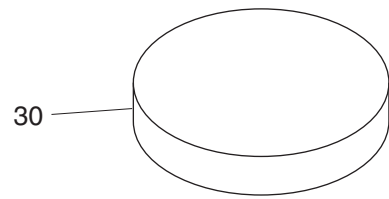
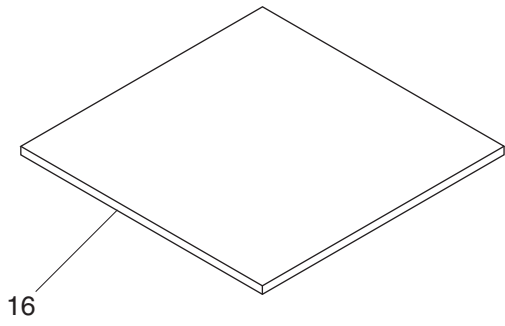
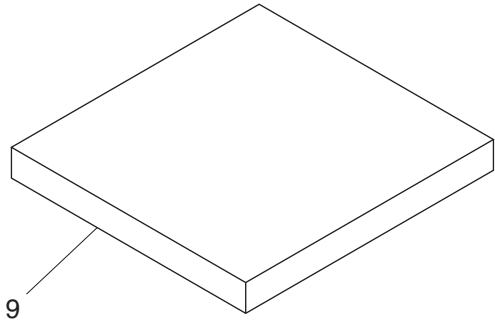


# Inventory



■ = Brass      □ = Aluminum or Steel







# Parts List & Inventory

Ref No.	Part ID	Part No.	Description	Quantity
1	HAE0301	PH8103001	ALUMINUM CYLINDER BLANK 40 X 20MM	1
2	HAE0314	PH8103002	BRASS CYLINDER BLANK 8 X 10MM	1
3	HAE0204	PH8103003	BRASS HEXAGON BLANK 5.5 X 36MM	1
4	HAE0302	PH8103004	BRASS PLATE BLANK 85 X 10 X 3MM	1
5	RB2-00	PH8103005	COOLING CYLINDER 40MM	1
6	HAE0215	PH8103006	BRASS CYLINDER BLANK 8 X 20MM	1
7	HAE0216	PH8103007	BRASS ROD BLANK 3 X 19MM	1
9	HAE0309	PH8103009	ALUMINUM PLATE BLANK 130 X 123 X 14MM	1
10	HAE0308	PH8103010	BRASS ROD BLANK 12 X 175MM	1
11	HAE0306	PH8103011	ALUMINUM CYLINDER BLANK 80 X 40MM	1
12	RQ2-00	PH8103012	HEATING CYLINDER 93MM	1
13	P01	PH8103013	WICK HOLDER	1
14	HAE0120	PH8103014	ALUMINUM CYLINDER BLANK 48 X 15MM	1
15	HAE0121	PH8103015	ALUMINUM CYLINDER BLANK 46 X 25MM	1
16	HAE0311	PH8103016	ALUMINUM PLATE BLANK 123 X 123 X 3.75MM	1
19	HAE0209	PH8103019	STEEL ROD BLANK 3 X 87MM	1
20	HAE0310	PH8103020	BRASS CYLINDER BLANK 10 X 40MM	1
21	HAE0307-01	PH8103021	A-FRAME STEEL BLANK	1
22	HAE0210	PH8103022	BRASS CYLINDER BLANK 8 X 17MM	1
23	HAE0128	PH8103023	BRASS HEXAGON BLANK 5.5 X 25MM	1
24	HAE0129	PH8103024	BRASS HEXAGON BLANK 5 X 17MM	1
25	HAE0313	PH8103025	BRASS PLATE BLANK 51 X 10 X 3MM	1
26	HAE0305	PH8103026	STEEL ROD BLANK 4 X 20MM	1
27	HAE0304	PH8103027	BRASS PLATE BLANK 23 X 10 X 3MM	2
28	HAE0303	PH8103028	STEEL ROD BLANK 4 X 36MM	2
30	HAE0312	PH8103030	ALUMINUM CYLINDER BLANK 92 X 17MM	1
32	HAE0307-02	PH8103032	BRASS CYLINDER BLANK 11 X 46MM	1
33	RB2-02	PH8103033	COOLING PISTON 22MM	1
34	RQ2.02-00	PH8103034	HEATING PISTON 63MM	1
35	HAE0315	PH8103035	ALUMINUM HOLLOW CYLINDER BLANK 25 X 13MM	1



# Machining Parts

The finished parts for your Stirling engine require precise machining and the equipment to do so. However, it is beyond the scope of this manual to provide instructions on how to machine these parts.

Use the machining specifications and illustrations beginning on **Page 12** to produce the parts required to assemble your Stirling engine (all dimensions are in millimeters).

**Note:** *Some parts have been pre-machined at our factory and are identified as such below. Also, there are some common fasteners and the wood base that are not included with this kit.*

When you have completed machining the parts, you should have the finished parts listed below. Reference this information, the **Assembly Diagram** on **Page 9**, and **Additional Assembly Instructions** on **Page 10** to complete the assembly of your Stirling engine.

## Finished Parts

Ref No.	Qty	Specs Page	Finished Part Description	Ref No.	Qty	Specs Page	Finished Part Description
1	1	12	Eccentric Drive Wheel	20	1	19	Heating Piston Drive Rod Shaft
2	1	13	Bushing	21	2	19	A-Frame Bracket
3	1	13	Brass Hex Bolt M3-.5 x 12	22	1	20	Slotted Pivot Connector #2
4	1	14	Cooling Piston Connector Rod	23	1	20	Brass Hex Bolt M3-.5 x 12
6	1	14	Slotted Pivot Connector #1	24	1	21	Brass Hex Nut M3-.5
7	1	15	Pin	25	1	21	Heating Piston Connector Rod
9	1	15	Mounting Plate	26	1	22	Axle 16mm
10	4	16	Threaded Support Shaft	27	2	22	Connecting Arm
11	1	16	Radiator	28	1	23	Axle 36mm
14	1	17	Fuel Reservoir Lid	30	1	23	Fly Wheel
15	1	17	Fuel Reservoir	32	2	24	Axle Shaft
16	1	18	Base Plate	35	1	24	Lock Collar
19	1	18	Heating Piston Drive Rod				

## Pre-Finished Parts

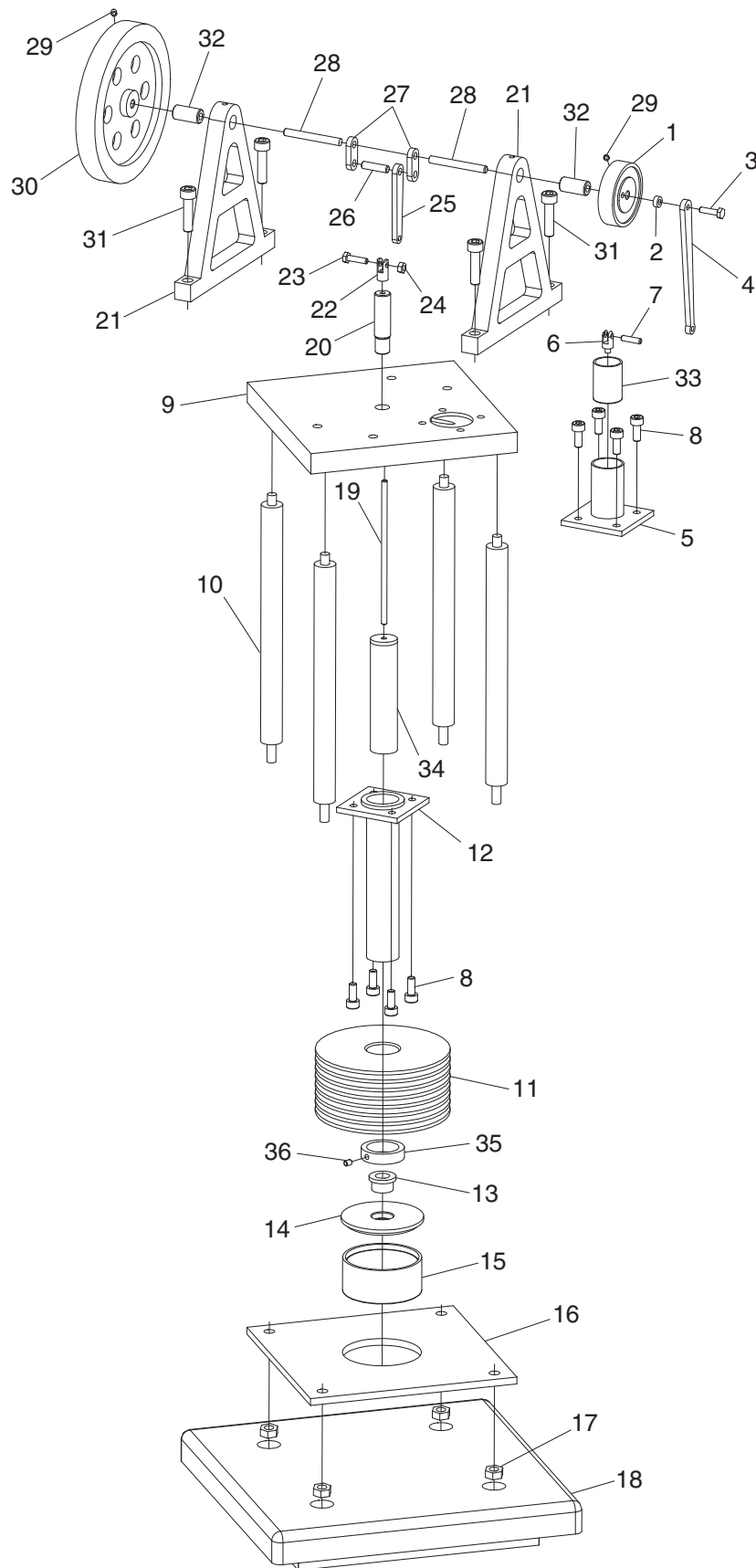
Ref No.	Qty	Finished Part Description	Ref No.	Qty	Finished Part Description
5	1	Cooling Cylinder	33	1	Cooling Piston
12	1	Heating Cylinder	34	1	Heating Piston
13	1	Wick Holder			

## Common Fasteners & Wood Base (not provided)

Ref No.	Qty	Description	Ref No.	Qty	Description
8	8	Cap Screw M4-.7 x 8	29	2	Set Screw M3-.5 x 10
17	4	Hex Nut M5-.8	31	4	Cap Screw M5-.8 x 16
18	1	Wood Base	36	1	Set Screw M3-.5 x 4



# Assembly Diagram



# Additional Assembly Instructions

As you enjoy assembling your Model H8103, take the opportunity to gain a better understanding of how your Stirling engine works.

Here are some general tips to help make your assembly process a successful experience:

- Establish a work area where the many small parts can be conveniently organized and stored.
- Make sure your hands and tools are clean and oil free when handling the parts. Dirt and grime will cause premature wear of the many moving parts.
- Use an aerosol can of compressed air or a clean brush to remove any debris you may find on the parts. Make sure each part is clean and dry before assembly.
- Take your time and be sure of the parts needed for each step—some of the parts appear very similar.
- Do not overtighten the fasteners. Many of the parts can be damaged by using excessive force.
- A very small amount of silicon lubricant may assist in assembling sliding parts.

Use the parts lists and **Assembly Diagram** beginning on **Page 9**, and the specific instructions in the following subsections to assemble your Stirling engine.

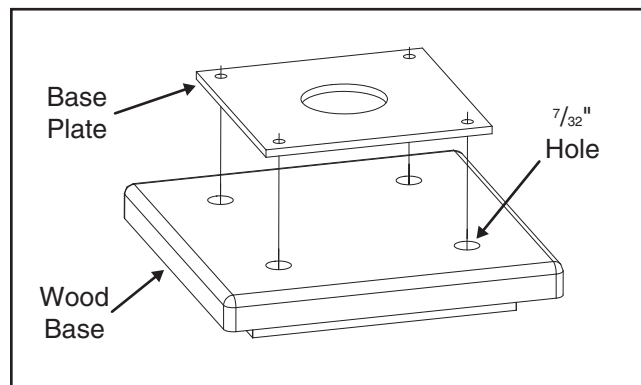
## Preparing the Base

Make and finish a wood base to your taste that is at least 1" wider on all sides than the base plate (see **Figure 1**).

The wood base needs four holes drilled to mount the Stirling engine assembly.

Position the base plate (**Ref 16**) on the wood base (**Ref 18**), and mark the position of the four holes onto the base.

**Note:** In the following instructions, parts will be referenced with the term **Ref** and a number. Use this reference number, the **Assembly Diagram** on **Page 9** to aid in part identification.

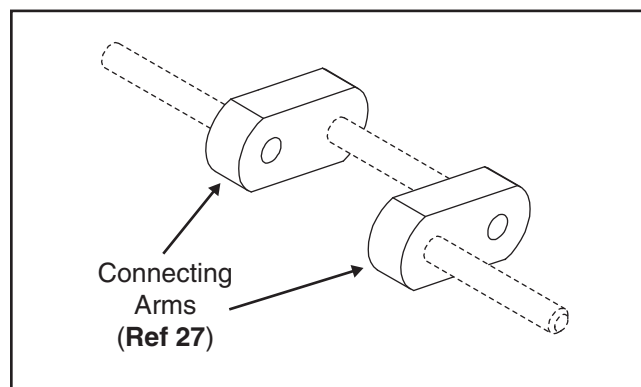


**Figure 1.** Base plate and wood base with location of holes to be drilled.

Drill four  $\frac{7}{32}$ " holes through the wood base, as shown in **Figure 1**.

## Positioning the Connecting Arms

When assembling the connecting arms (**Ref 27**) with the axles and other linkage, be sure that both connecting arms are even and aligned with one another, as shown in **Figure 2**.

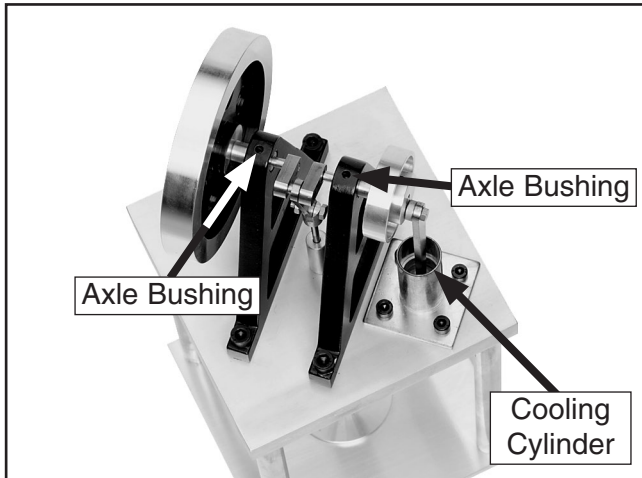


**Figure 2.** Connecting arms in correct alignment.




# Lubrication

After you have completed the assembly of your Stirling engine, apply a drop or two of light machine oil at the three lubrication points shown in **Figure 3**. Re-lubricate as needed after use.



**Figure 3.** Model H8103 lubrication locations.

# Operation

	<p><b>!WARNING</b> Isopropyl alcohol is an extremely flammable and volatile liquid. Clean up any spills of alcohol and secure the fuel reservoir lid before lighting the wick. Keep all other flammable materials away from the engine during operation. Failure to heed this warning could result in serious property damage and personal injury.</p>
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When all of the assembly is finished and lubrication is complete, it is time to "fire up" your Stirling engine!

## To operate your Stirling engine:

1. Make sure you have read and complied with all of the safety warnings in this manual, and have prepared your operation environment appropriately.
2. Fill the reservoir about  $\frac{3}{4}$  full of 99% pure isopropyl alcohol and mount the reservoir lid with the wick showing only about  $\frac{1}{2}$ ".
3. Clean up any spills and remove the surplus fuel container away from the engine.
4. Place the reservoir into the provided base plate hole underneath the heating cylinder.
5. When you are ready, carefully light the wick.

**Note:** *It may be necessary to spin the large flywheel by hand to start the engine moving.*

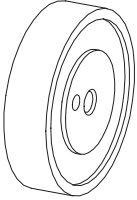
6. When you are finished using the engine, extinguish the wick and return the remaining alcohol safely back into the surplus container.



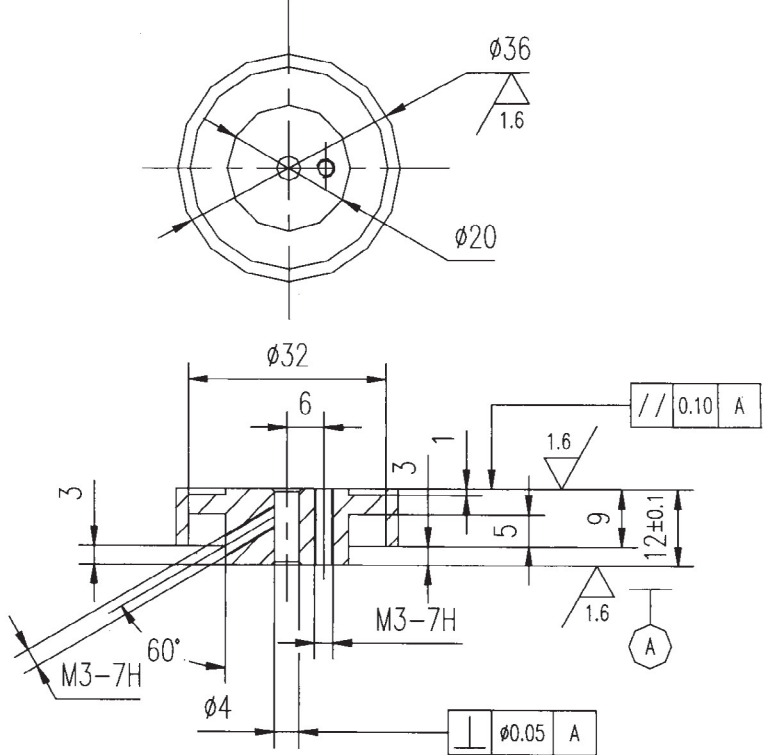
# Machining Specifications

Ref No.: <b>1</b>	Material	Qty To Make	Blank Description: <b>Aluminum Cylinder Blank 40 x 20mm</b>
Part No.: <b>PH8103001</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Eccentric Drive Wheel</b>




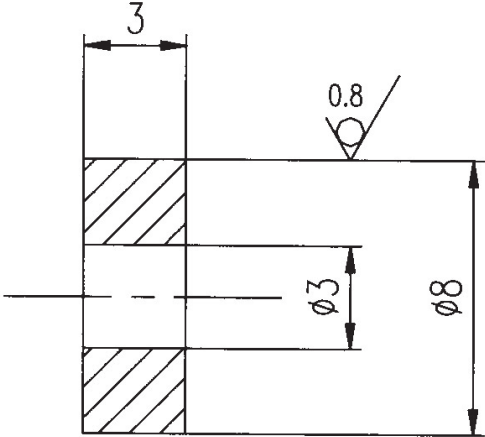
Not To Scale

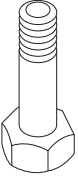
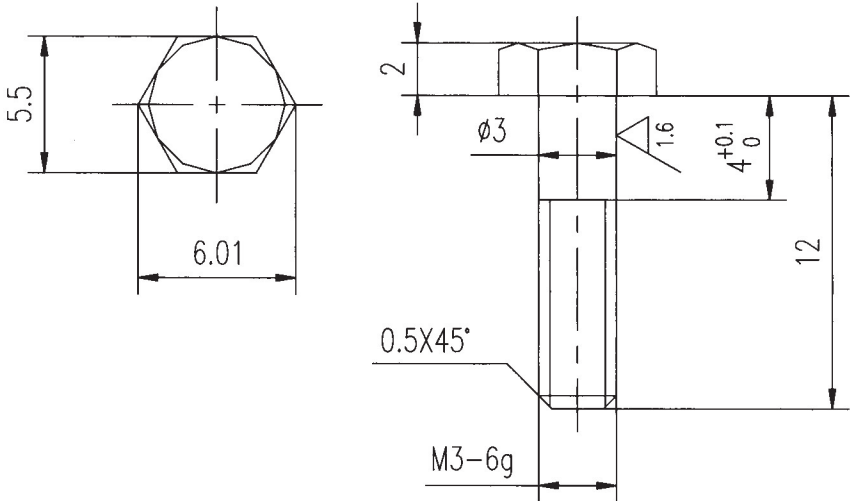


The technical drawing includes a top view showing an outer diameter of  $\phi 36$  and an inner diameter of  $\phi 20$ . The side view shows a total length of 12  $\pm 0.1$  mm. Key features include a 60-degree chamfered end with an M3-7H thread, a central hole with a diameter of  $\phi 4$ , and a section with a diameter of  $\phi 32$  and a length of 6 mm. Surface finish requirements are specified as 1.6 for several surfaces and a flatness tolerance of 0.10 A for the top surface.

**Note:** All dimensions are in millimeters.

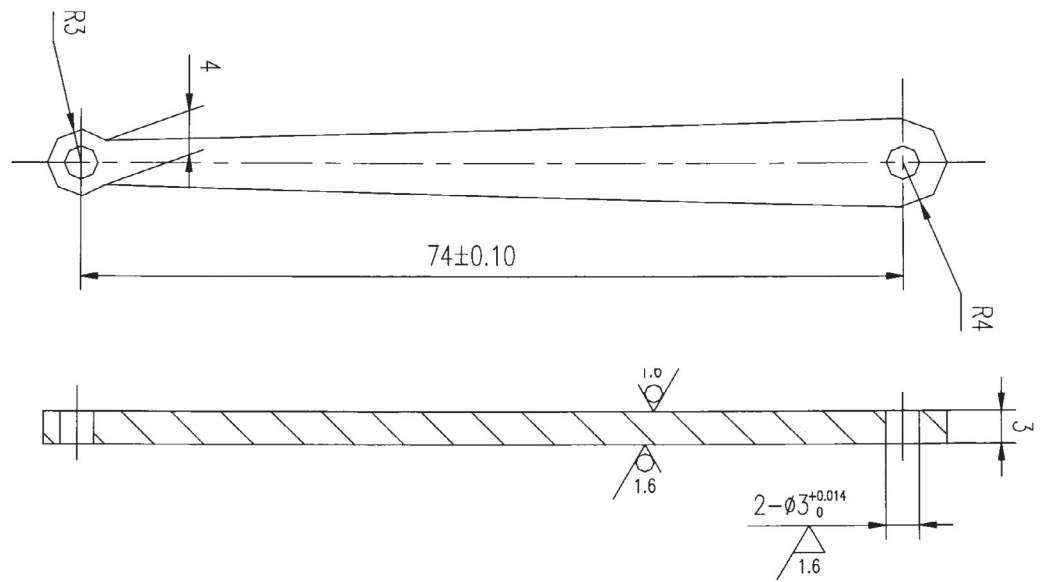
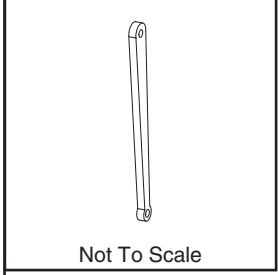


Ref No.: <b>2</b>	Material	Qty To Make	Blank Description: <b>Brass Cylinder Blank 8 x 10mm</b>
Part No.: <b>PH8103002</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Bushing</b>
 <p>Not To Scale</p>  <p><b>Note:</b> All dimensions are in millimeters.</p>			

Ref No.: <b>3</b>	Material	Qty To Make	Blank Description: <b>Brass Hexagon Blank 5.5 x 36mm</b>
Part No.: <b>PH8103003</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Brass Hex Bolt M3-.5 x 12</b>
 <p>Not To Scale</p>  <p><b>Note:</b> All dimensions are in millimeters.</p>			

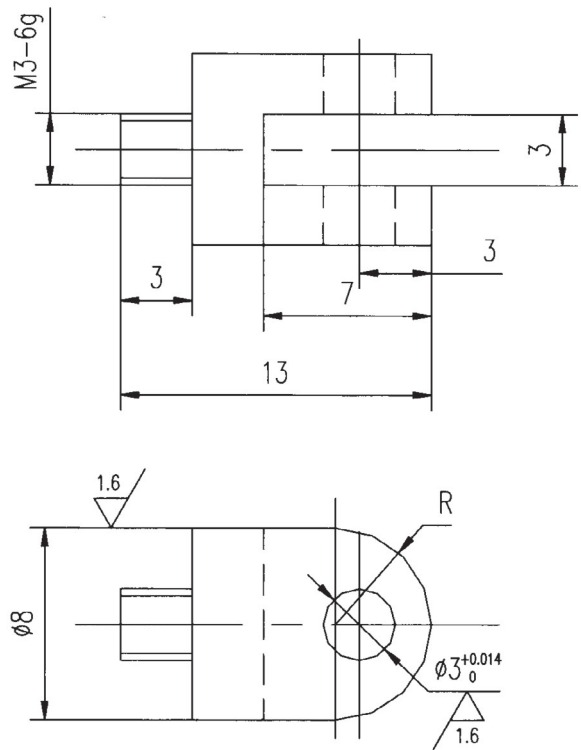
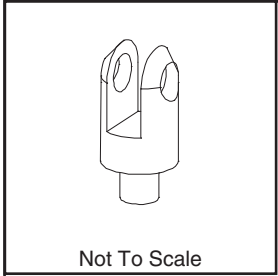


Ref No.: <b>4</b>	Material	Qty To Make	Blank Description: <b>Brass Plate Blank 85 x 10 x 3mm</b>
Part No.: <b>PH8103004</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Cooling Piston Connector Rod</b>



**Note:** All dimensions are in millimeters.

Ref No.: <b>6</b>	Material	Qty To Make	Blank Description: <b>Brass Cylinder Blank 8 x 20mm</b>
Part No.: <b>PH8103006</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Slotted Pivot Connector #1</b>

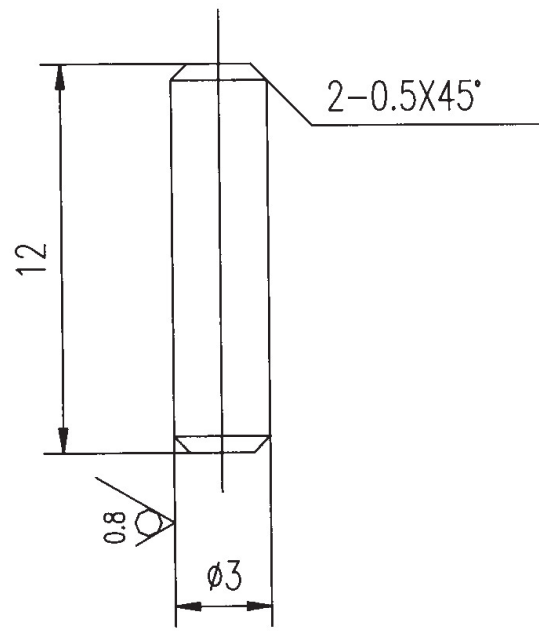
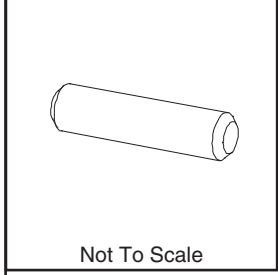


**Note:** All dimensions are in millimeters.



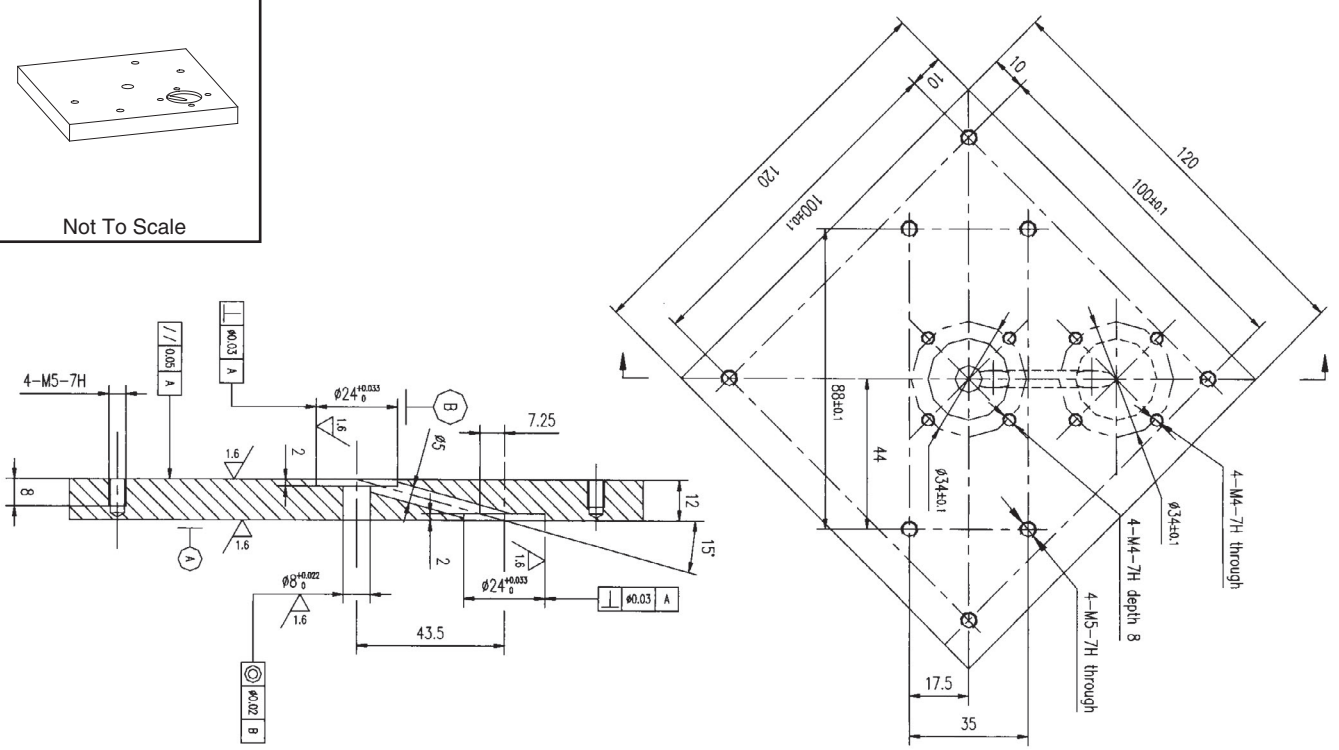
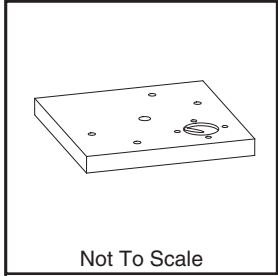


Ref No.: <b>7</b>	Material	Qty To Make	Blank Description: <b>Brass Rod Blank 3 x 19mm</b>
Part No.: <b>PH8103007</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Pin 3 x 12mm</b>



**Note:** All dimensions are in millimeters.

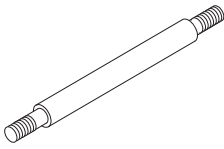
Ref No.: <b>9</b>	Material	Qty To Make	Blank Description: <b>Aluminum Plate Blank 130 x 123 x 14mm</b>
Part No.: <b>PH8103009</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Mounting Plate</b>



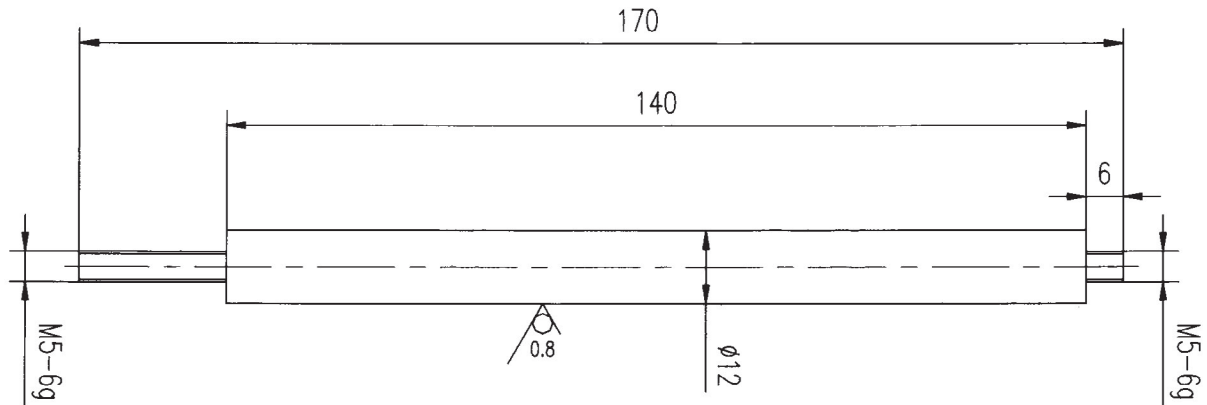
**Note:** All dimensions are in millimeters.



Ref No.: <b>10</b>	Material	Qty To Make	Blank Description: <b>Brass Rod Blank 12 x 175mm</b>
Part No.: <b>PH8103010</b>	<b>Brass</b>	<b>4</b>	Finished Part Description: <b>Threaded Support Staff</b>

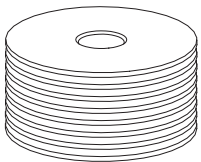


Not To Scale

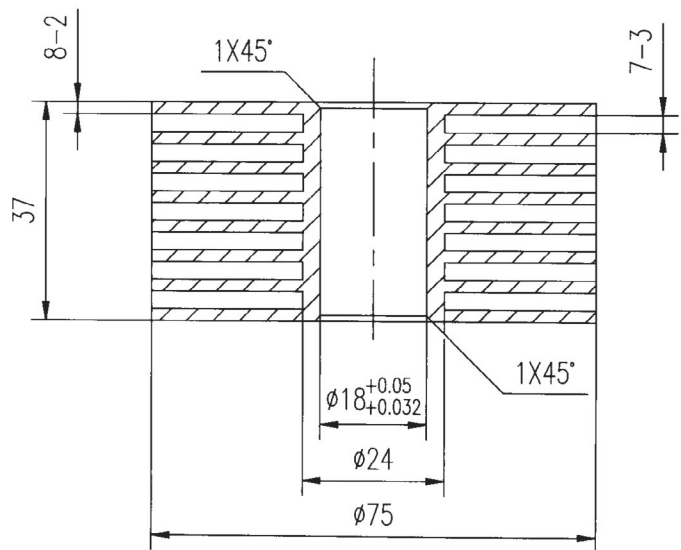
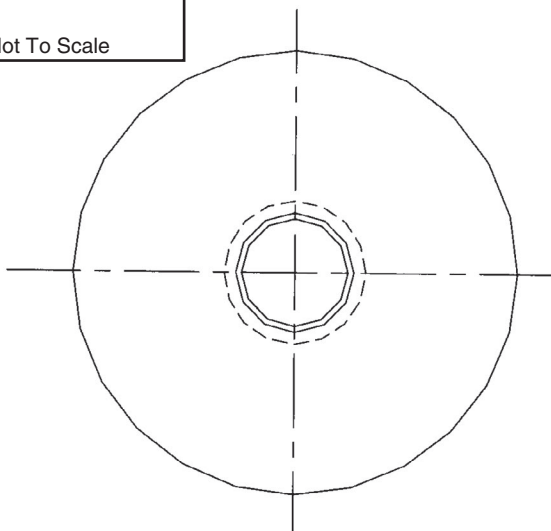


**Note:** All dimensions are in millimeters.

Ref No.: <b>11</b>	Material	Qty To Make	Blank Description: <b>Aluminum Cylinder Blank 80 x 40mm</b>
Part No.: <b>PH8103011</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Radiator</b>



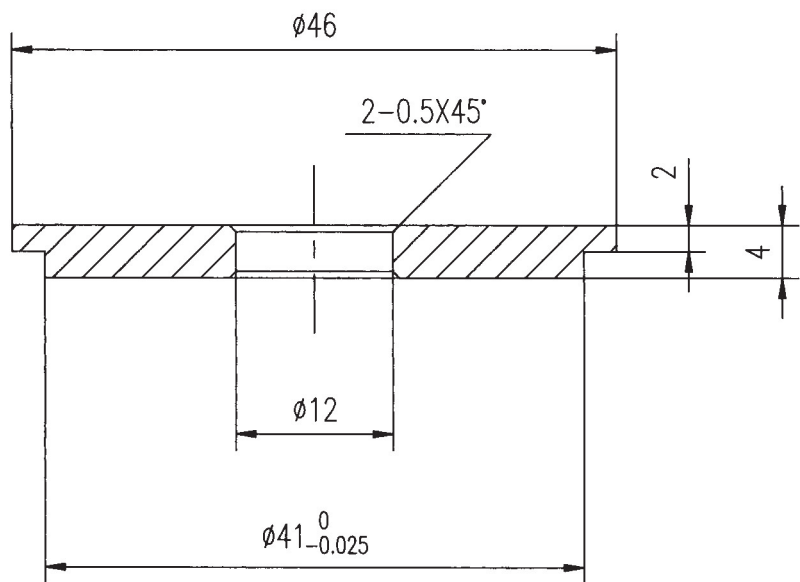
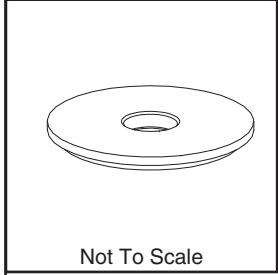
Not To Scale



**Note:** All dimensions are in millimeters.

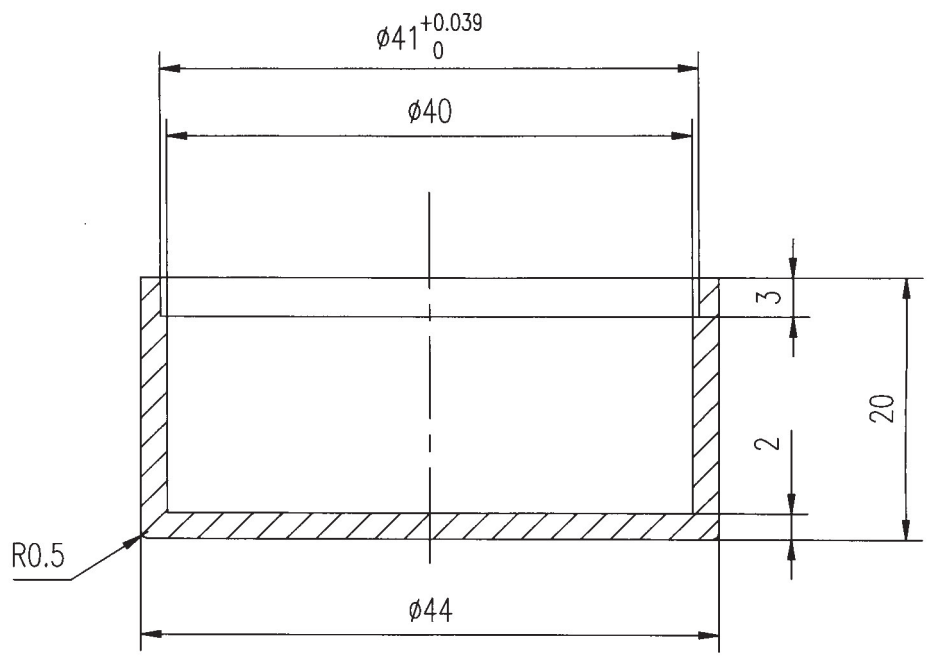
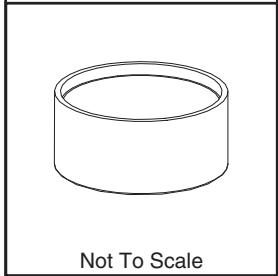


Ref No.: <b>14</b>	Material	Qty To Make	Blank Description: <b>Aluminum Cylinder Blank 48 x 15mm</b>
Part No.: <b>PH8103014</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Fuel Reservoir Lid</b>



**Note:** All dimensions are in millimeters.

Ref No.: <b>15</b>	Material	Qty To Make	Blank Description: <b>Aluminum Cylinder Blank 46 x 25mm</b>
Part No.: <b>PH8103015</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Fuel Reservoir</b>

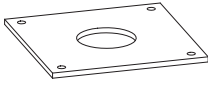


**Note:** All dimensions are in millimeters.

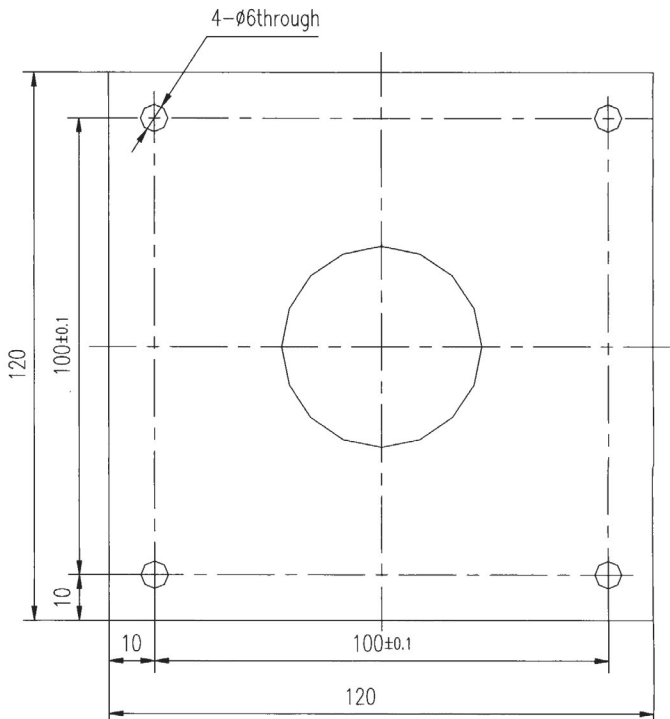


Ref No.: <b>16</b>	Material	Qty To Make	Blank Description: <b>Aluminum Plate Blank 123 x 123 x 3.75mm</b>
Part No.: <b>PH8103016</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Base Plate</b>



Not To Scale




4- $\phi$ 6through

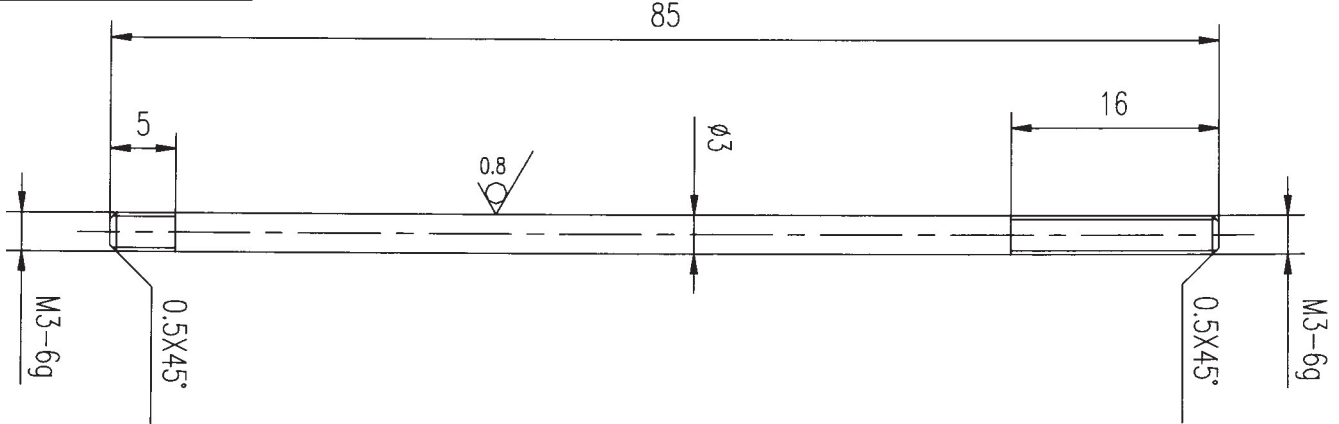
**Note:** All dimensions are in millimeters.

Ref No.: <b>19</b>	Material	Qty To Make	Blank Description: <b>Steel Rod Blank 3 x 87mm</b>
Part No.: <b>PH8103019</b>	<b>Steel</b>	<b>1</b>	Finished Part Description: <b>Heating Piston Drive Rod 85mm</b>



Not To Scale



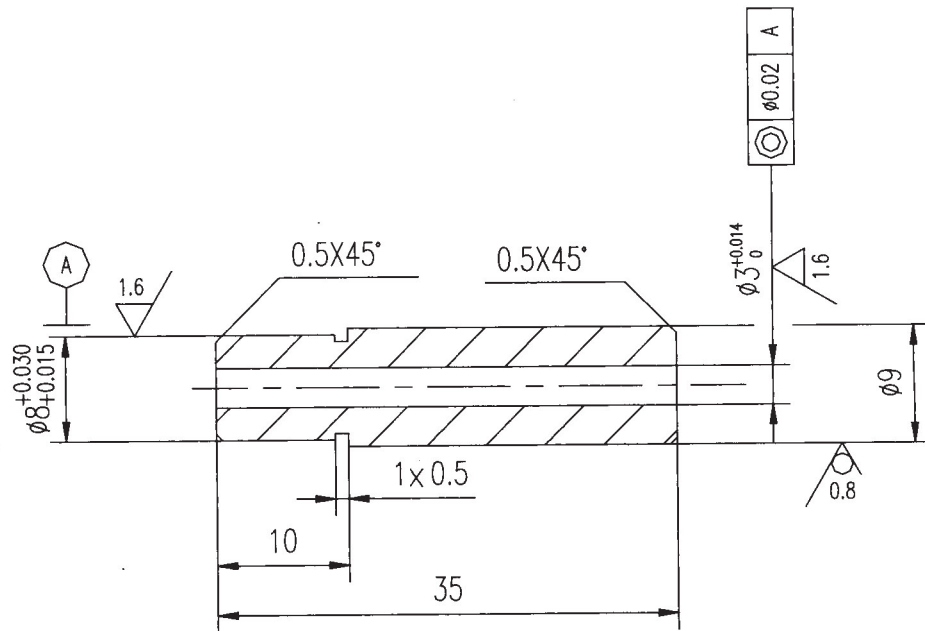
**Note:** All dimensions are in millimeters.



Ref No.: <b>20</b>	Material	Qty To Make	Blank Description: <b>Brass Cylinder Blank 10 x 40mm</b>
Part No.: <b>PH8103020</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Heating Piston Drive Rod Shaft</b>

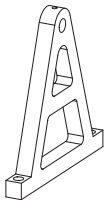


Not To Scale

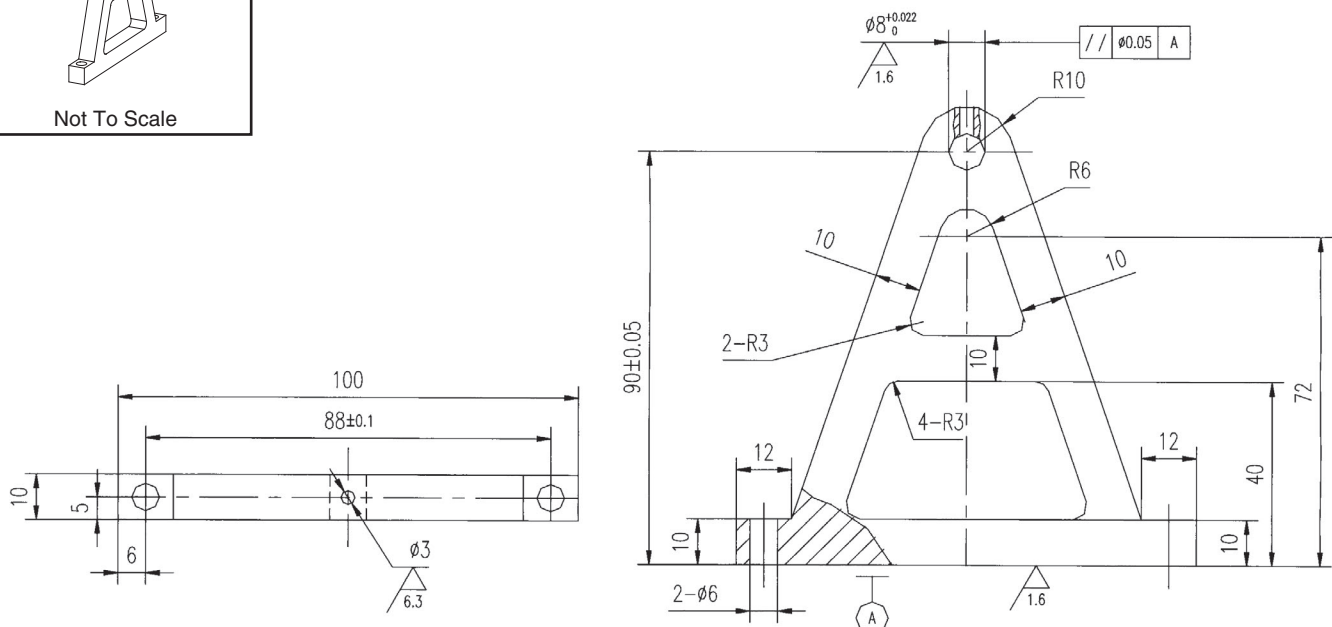


**Note:** All dimensions are in millimeters.

Ref No.: <b>21</b>	Material	Qty To Make	Blank Description: <b>Steel A-Frame Blank</b>
Part No.: <b>PH8103021</b>	<b>Steel</b>	<b>2</b>	Finished Part Description: <b>A-Frame Bracket</b>

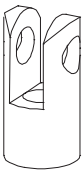
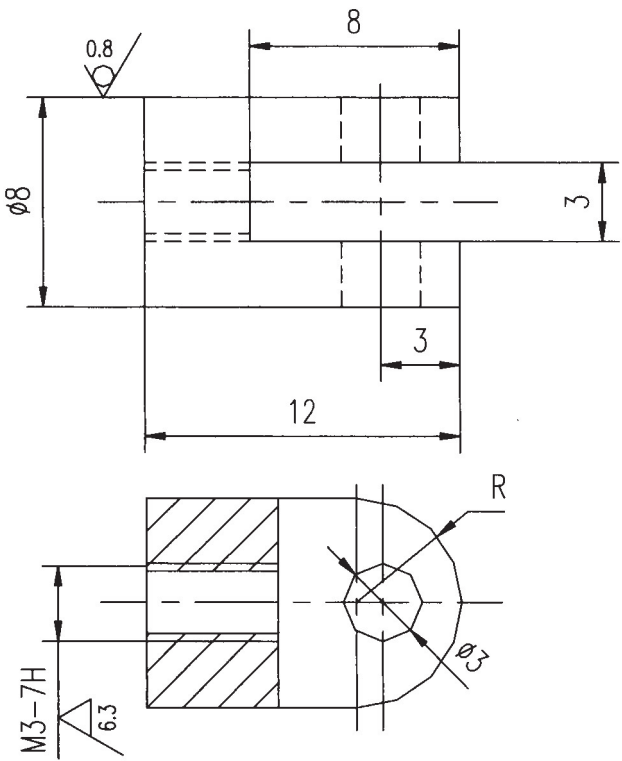


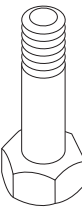
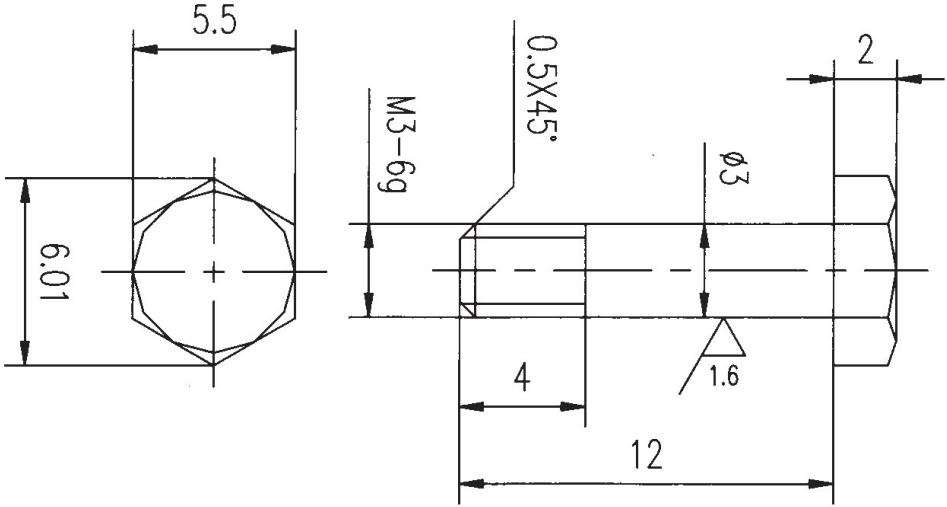
Not To Scale



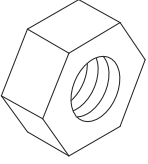
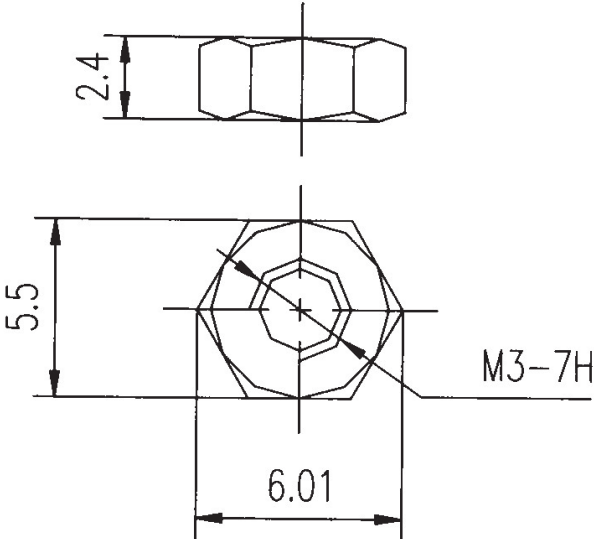
**Note:** All dimensions are in millimeters.


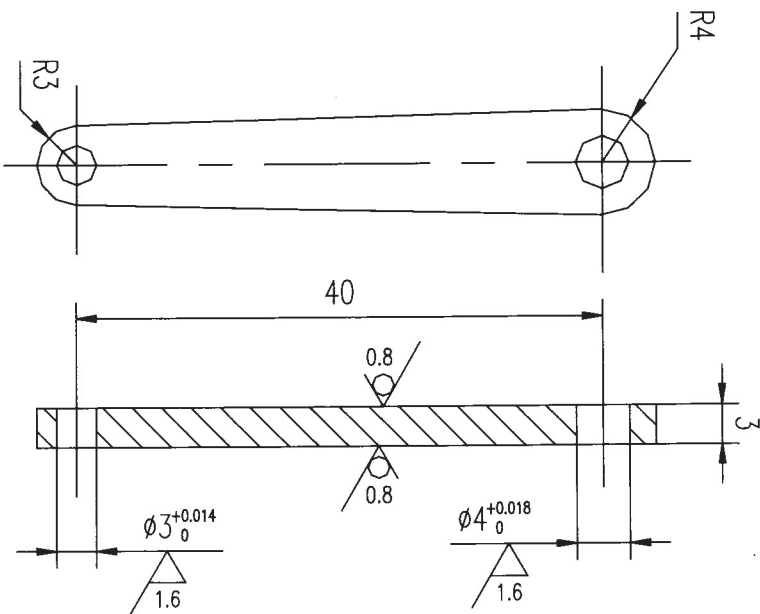


Ref No.: <b>22</b>	Material	Qty To Make	Blank Description: <b>Brass Cylinder Blank 8 x 17mm</b>
Part No.: <b>PH8103022</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Slotted Pivot Connector #2</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

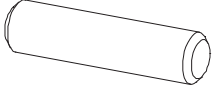
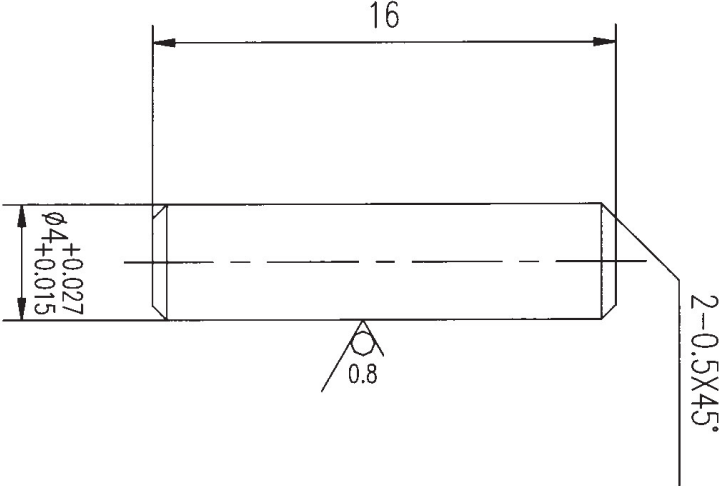
Ref No.: <b>23</b>	Material	Qty To Make	Blank Description: <b>Brass Hexagon Blank 5.5 x 25mm</b>
Part No.: <b>PH8103023</b>	<b>Brass</b>	<b>1</b>	Finished Part Description: <b>Brass Hex Bolt M3-.5 x 12</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

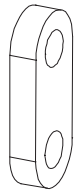
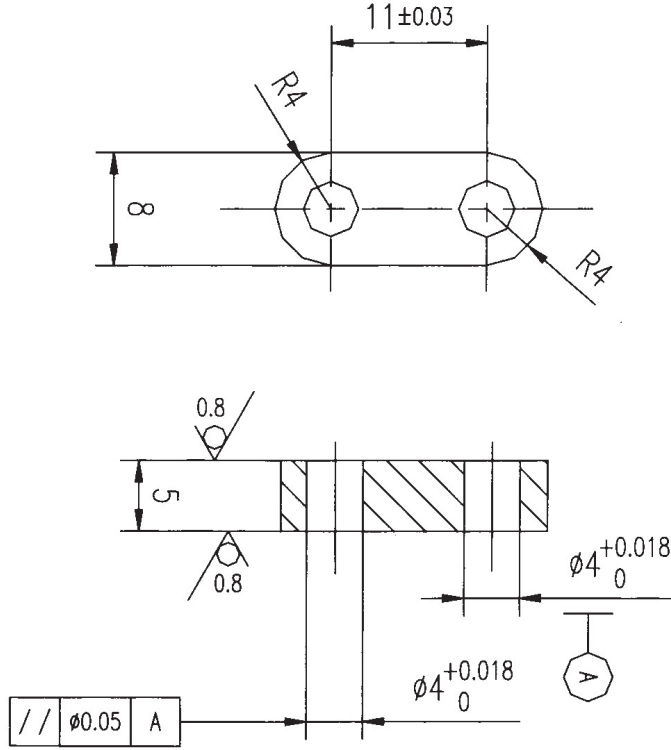


Ref No.: <b>24</b>	Material <b>Brass</b>	Qty To Make <b>1</b>	Blank Description: <b>Brass Hexagon Blank 5 x 17mm</b>
Part No.: <b>PH8103024</b>			Finished Part Description: <b>Brass Hex Nut M3-5</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

Ref No.: <b>25</b>	Material <b>Brass</b>	Qty To Make <b>1</b>	Blank Description: <b>Brass Plate Blank 51 x 10 x 3mm</b>
Part No.: <b>PH8103025</b>			Finished Part Description: <b>Heating Piston Connector Rod</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			


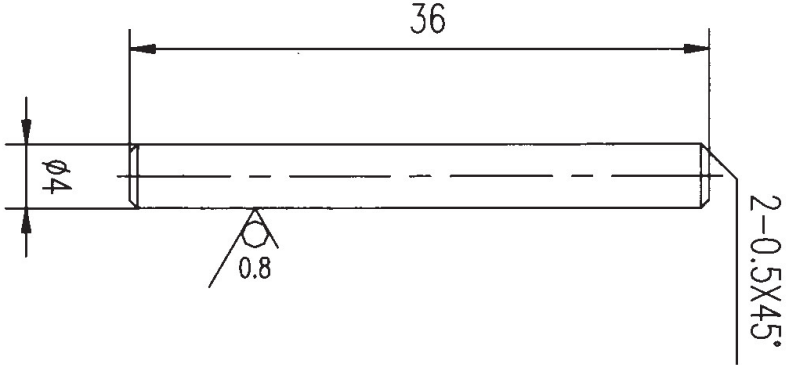


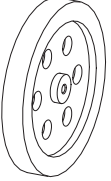
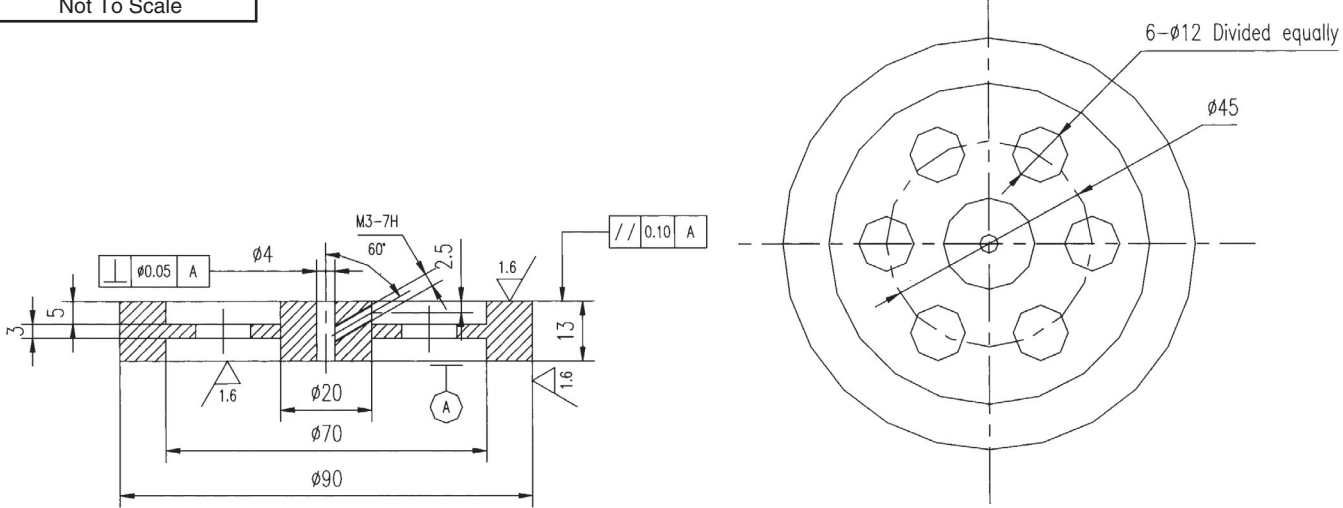
Ref No.: <b>26</b>	Material	Qty To Make	Blank Description: <b>Steel Rod Blank 4 x 20mm</b>
Part No.: <b>PH8103026</b>	<b>Steel</b>	<b>1</b>	Finished Part Description: <b>Axle 16mm</b>
 <p>Not To Scale</p>			
			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

Ref No.: <b>27</b>	Material	Qty To Make	Blank Description: <b>Brass Plate Blank 23 x 10 x 3mm</b>
Part No.: <b>PH8103027</b>	<b>Brass</b>	<b>2</b>	Finished Part Description: <b>Connecting Arm</b>
 <p>Not To Scale</p>			
			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

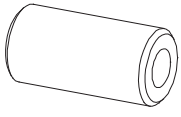
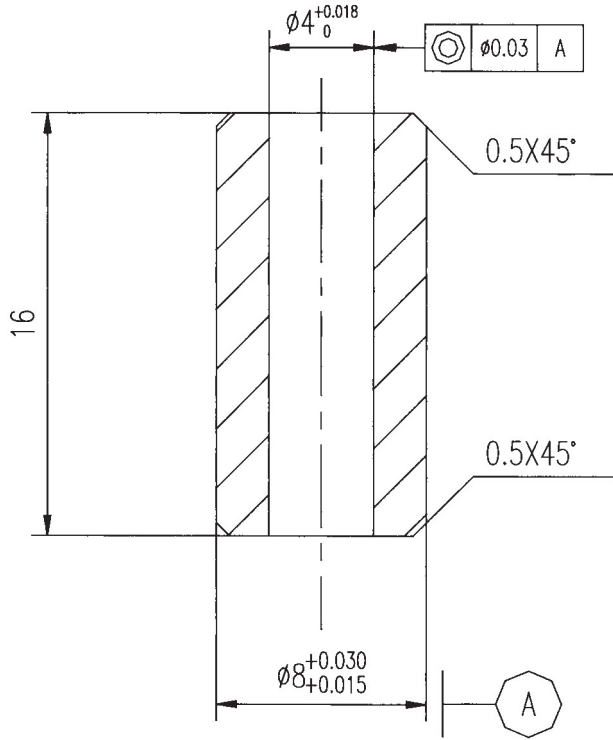


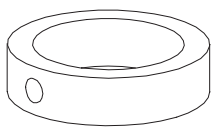
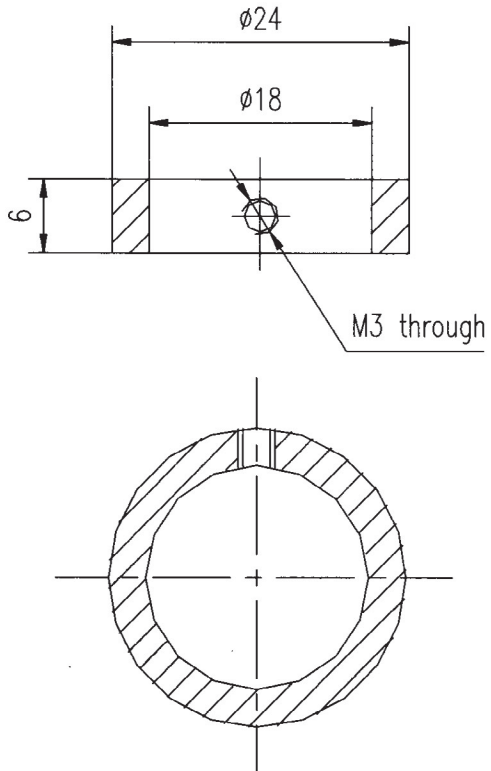


Ref No.: <b>28</b>	Material	Qty To Make	Blank Description: <b>Steel Rod Blank 4 x 36mm</b>
Part No.: <b>PH8103028</b>	<b>Steel</b>	<b>2</b>	Finished Part Description: <b>Axle 36mm</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

Ref No.: <b>30</b>	Material	Qty To Make	Blank Description: <b>Aluminum Cylinder Blank 92 x 17mm</b>
Part No.: <b>PH8103030</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Fly Wheel</b>
 Not To Scale			
<p><b>Note:</b> All dimensions are in millimeters.</p>			



Ref No.: <b>32</b>	Material	Qty To Make	Blank Description: <b>Brass Cylinder Blank 11 x 46mm</b>
Part No.: <b>PH8103032</b>	<b>Brass</b>	<b>2</b>	Finished Part Description: <b>Axle Shaft</b>
 <p>Not To Scale</p>			
<p><b>Note:</b> All dimensions are in millimeters.</p>			

Ref No.: <b>35</b>	Material	Qty To Make	Blank Description: <b>Aluminum Hollow Cylinder Blank 25 x 13mm</b>
Part No.: <b>PH8103035</b>	<b>Aluminum</b>	<b>1</b>	Finished Part Description: <b>Lock Collar</b>
 <p>Not To Scale</p>			
<p><b>Note:</b> All dimensions are in millimeters.</p>			



# WARRANTY AND RETURNS

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Grizzly Industrial, Inc. warrants every product it sells for a period of **1 year** to the original purchaser from the date of purchase. This warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence, accidents, repairs or alterations or lack of maintenance. This is Grizzly's sole written warranty and any and all warranties that may be implied by law, including any merchantability or fitness, for any particular purpose, are hereby limited to the duration of this written warranty. We do not warrant or represent that the merchandise complies with the provisions of any law or acts unless the manufacturer so warrants. In no event shall Grizzly's liability under this warranty exceed the purchase price paid for the product and any legal actions brought against Grizzly shall be tried in the State of Washington, County of Whatcom.

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The manufacturers reserve the right to change specifications at any time because they constantly strive to achieve better quality equipment. We make every effort to ensure that our products meet high quality and durability standards and we hope you never need to use this warranty.

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